VOL. XVII. MAY, 1892. NO. 5.

THE BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, University of Indiana, Bloomington, Ind.
CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

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[ISSUED MAY 17.]

BLOOMINGTON, INDIANA.
PUBLISHED BY THE EDITORS.

Tracy, Gibbs & Co., Printers, Madison, Wisconsin.

THE BOTANICAL GAZETTE.

A Monthly Journal Embracing all Departments of Botanical Science.

ANNUAL SUBSCRIPTION, $2.50.

SINGLE NUMBERS, 25 CENTS.

The subscription price is an invariable one, no concession being made to dealers or agents.

In Great Britain, 11 shillings.	In Germany, 11 marks.
Agent, W. P. COLLINS,	Agents, R. FRIEDLÆNDER & SOHN,
157 Great Portland St., London, W.	Carlstrasse 11, Berlin, N. W. 6.

Subscriptions and correspondence should be addressed to **Charles R. Barnes, 712 Langdon St., Madison, Wisconsin**; money orders and drafts should be made payable to the BOTANICAL GAZETTE.

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In the June number will appear:

On nomenclature, by the late SERENO WATSON.

The North American Lejeuneæ, by F. STEPHANI, *Leipzig, Germany.*

The identification of trees in winter, by AUGUST F. FOERSTE, *Paris, France.*

Two new genera of Hyphomycetes, by A. P. MORGAN, *Preston, Ohio.*

Flowers and insects, VIII, by CHARLES ROBERTSON, *Carlinville, Ills.*

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INTERIOR of GRAY HERBARIUM.

BOTANICAL GAZETTE

MAY, 1892.

Sereno Watson.

JOHN M. COULTER.

(WITH PLATES VI AND VII.[1])

Sereno Watson was born December 1, 1826, at East Windsor Hill, Connecticut. He graduated from Yale College in 1847; taught school for several years in different states; studied medicine at the University of New York; was a practicing physician for two years at Quincy, Illinois; was secretary of the Planters' Insurance Company of Greensboro, Alabama, from 1856 to 1861; became a professional botanist in 1868; was botanist of Clarence King's U. S. Geological Survey during the seasons of 1868 and 1869; became Professor Gray's assistant at Cambridge in 1871; and was made Curator of the Gray Herbarium and Library in 1888, a position which he held at the time of his death, March 9, 1892.[2]

Such are the prominent dates and positions connected with the life of one who, at his death, was the most distinguished American student of systematic botany. His work will speak for itself, but the real flavor of his quiet life is known only to those of us who were fortunate enough to be intimately associated with him. To the chance visitor or casual acquaintance he seemed painfully reticent and unresponsive, but he hesitated at no trouble in serving those who sought his help; and many American botanists will always cherish the memory of his kindly, unrequited assistance. The priceless herbarium, under his care, still had the atmosphere of helpfulness so characteristic of its great founder. To turn from the memories of the friend to the cold recital of the work of the botanist is a necessary but uncongenial task.

[1] The portrait (plate VI) is from a photograph by Pach, taken in January, 1887. It is selected by a friend as the best likeness of Dr. Watson. The herbarium interior (plate VII) is from a photograph taken about 1880.

[2] I am indebted to "Garden and Forest" (March 16) for the facts with reference to Dr. Watson's earlier life.

Sereno Watson appeared suddenly in the botanical world. So far as we know, he had no puerile work to lament, the common experience of most botanists, but when known as a botanist at all he was in the foremost rank. This stepping at once, full-equipped, among the leaders, without any preliminary service, is one of the distinguishing marks of his botanical career.

His apparently accidental connection as botanist with the U. S. Geological Survey under Clarence King was the occasion of his sudden celebrity as a botanist. Botanical collectors had visited the great west before and have multiplied since, but Watson brought back from the Great Basin region not only a magnificent collection of plants, but also such an ability to study it, that his report, technically known as the "Botany of the 40th parallel" (vol. V of the Clarence King's Reports), has become one of the classics of American botany. The appearance of this work in 1871 was the first announcement that America had another great botanist.

From that time he was the constant associate of Dr. Gray, devoting himself entirely to the study of the North American flora.

In 1876 there appeared the first volume of the Botany of California, a most elaborate presentation of the unique flora of the Pacific coast region. This volume was the joint work of Dr. Watson, Professor Brewer, and Dr. Gray; the first two elaborating the Polypetalae, the Gamopetalae falling to Dr. Gray. The second volume, appearing in 1880, was the sole work of Dr. Watson; and it was in this volume that his presentation of the mosses, although not a professed bryologist, showed the remarkable taxonomic power he possessed. This contact with the mosses led to his being asked, upon the death of Mr. Thomas P. James in 1882, to take editorial charge of Lesquereux and James' "Mosses of North America," then in press. This involved a vast amount of critical and editorial labor, and must have seemed a sad waste of time to a man overwhelmingly busy in other directions.

In 1878 there appeared the first part of his "Bibliographical Index", including the Polypetalae of North America. It is a great loss to American botany that Dr. Watson was not able to prepare the remaining parts, especially those including the Apetalae and Monocotyls. The only part that appeared, however, has been an immensely useful book; and

it must always stand as a monument to the patient, systematic, drudgery-enduring nature of the man. It is far more than a careful collaboration of references and synonymy; for it necessitated the revision of many groups and contains views unrepresented elsewhere. I imagine that no book has been more consulted by students of the North American flora than this one; in fact, in lack of a volume of the Synoptical Flora covering the same ground, this volume of the Bibliographical Index was all that made the study of North American Polypetalae possible in many herbaria. The number who have leaned upon Dr. Watson for synonymy and dates is far greater than their acknowledgement of such laborious but thankless service.

At the death of Dr. Gray, the writer had in hand a revision of Gray's Manual upon entirely new lines. The chief purpose was to enlarge its range and revise its nomenclature, but Dr. Gray had also planned a different style of presentation, and had furnished complete manuscripts of two or three small families as patterns. This work was brought to a sudden close by the death of Dr. Gray and the transfer of his copyrights to Harvard University. As is well known, however, the manual was revised, the work being assigned to Dr. Watson and the writer. It was really an imposition upon the former, for he could not take such responsibility lightly and did far more time-consuming work of revision than the necessities of the case demanded. The result was a manual more closely following the old lines than Dr. Gray had intended, but still fully as useful to the vast majority who use it.

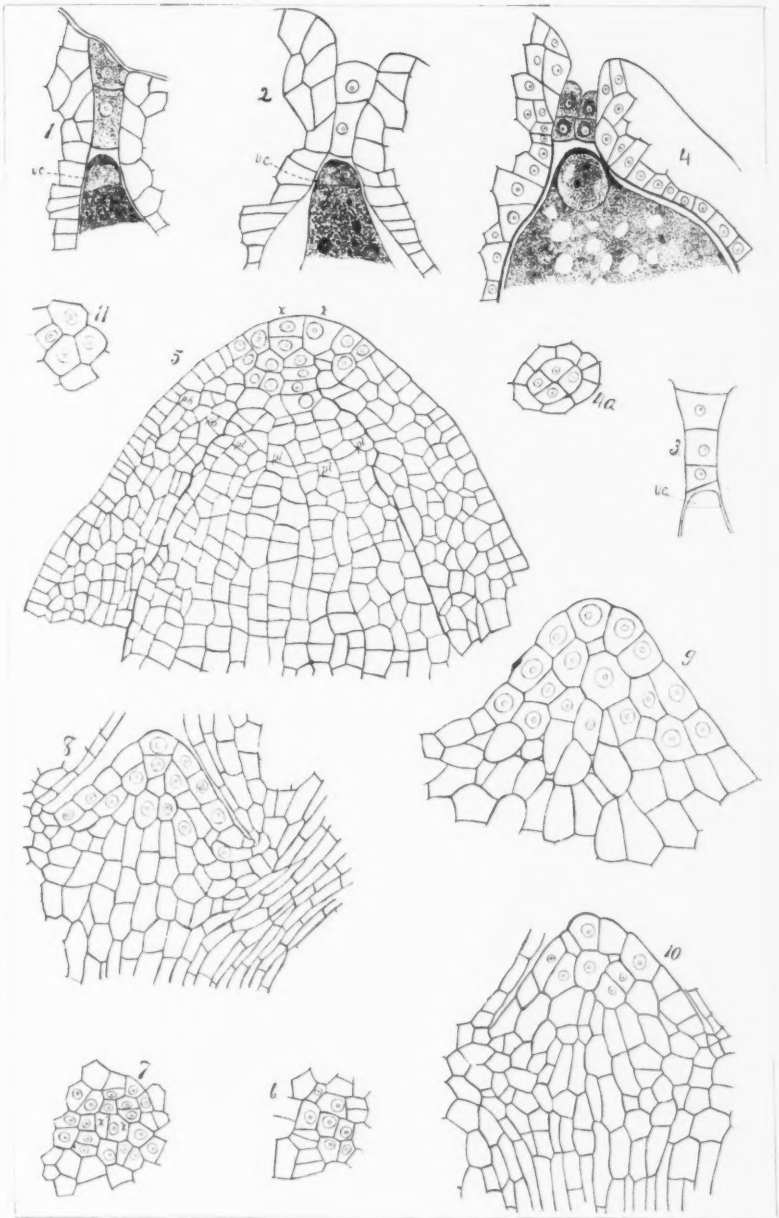
The series of "Contributions to American Botany" which bears Dr. Watson's name represents some of our most important systematic literature. The series reached 18 in number, and extended from May 1873 to July 1891, chiefly in the Proceedings of the American Academy. In this series, his name is associated with the revision of the following orders: Chenopodiaceae and Liliaceae; and with the following genera: Lupinus, Potentilla, Œnothera, Ceanothus, Trifolium, Lathyrus, Megarhiza, Peucedanum, Lychnis, Eriogonum, Chorizanthe, and Rosa.

A large amount of his time was occupied in elaborating the rich Mexican collections of Pringle, and scores of new Mexican genera and species will always speak of his connection with that flora.

After Dr. Gray's death it was a fitting thing to so arrange Dr. Watson's time that he could have abundant opportunity to continue the "Synoptical Flora," and botanists were satisfied that this work would be continued more nearly in the spirit of its great author than in the hands of any other botanist. But now not a published page has been added, and our greatest botanical work bids fair to remain even more incomplete than its forerunner, the Flora of North America. However, much work had been done among the polypetalous orders, and it is to be hoped that that part at least can appear with something like completeness.

As a botanist, Dr. Watson was thorough and painstaking, the charge of hasty conclusions never having been laid at his door. His whole training and disposition compelled him to occupy a conservative position in the midst of the perturbations of sequence and nomenclature. He had to be very sure that right conclusions had been reached before his consent could be given; but his conservative views were never offensive and never appeared in public discussion. His disposition was simply to wait until things became more settled, and in the mean time to work quietly along in his own way. It has always seemed to the writer that Dr. Watson was remarkably gifted for doing safe systematic work. Lacking the grasp, the originality, the inspiration of our greatest botanist, he yet had that clear analytic vision and unflinching patience that lead to the best results. As I have heard him say: "I never can remember anything, but I can work it out"; and this seems to express his peculiar quality. It must be said in justice, however, that Dr. Watson's position in matters of ordinal arrangement was not so conservative as his writings would seem to indicate. His views on this point were clear and original. Recognizing the temporary nature of our present fabric of classification, he has frequently discussed with the writer the changes which were imminent, and only withheld a concrete public expression of his views because he did not deem his knowledge or any one's knowledge of affinities sufficient.

Systematic botany has lost another one of its great exponents, another one of that generation which is fast passing away. What the new generation is to do for the science is hard to predict, but it is evident that as the old leaders disappear we are to become more of a democracy. Sereno Watson's



MOTTIER on TSUGA and PINUS.

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place in the study of botany of this country can not be filled, for the conditions which made him have disappeared; but to many of us this loss will appear secondary, because we especially cherish the memory of the kind and helpful friend.

Indiana University, Bloomington.

On the archegonium and apical growth of the stem in Tsuga Canadensis and Pinus sylvestris.

D. M. MOTTIER.

(WITH PLATE VIII.)

To determine the true relationship existing between the different groups of the plant kingdom is yet a problem of great interest to botanists. The genealogical tree is still largely hypothetical and must necessarily remain so for some time to come. Now and then modern research fills up a gap or throws some light on the true line of development.

The gymnosperms, holding as they do a position between the pteridophytes and angiosperms, are perhaps as interesting as perplexing. It is, however, chiefly in the study of the reproduction, the development of the embryo and the meristems of stem and root that we are to look for the true affinities of the neighboring groups.

Several representative types of the gymnosperms have been carefully studied by Hofmeister and, later, by Strasburger and others. Since more accurate methods have come into use some of the work done by these botanists has been repeated, especially in cases concerning which there was doubt or difference of opinion.

Having had material in abundance, I recently made a careful study of the development of the archegonium in Tsuga Canadensis and Pinus sylvestris and found that in a few details my results do not quite agree with the account of Strasburger.[1] This investigator states that he can not affirm Hofmeister's statement that the neck of the archegonium of Tsuga Canadensis consists of two cells, one lying above the other, but that it remains one-celled, and only in rare cases did he find two. In a large number of specimens examined I found

[1] Die Befruchtung bei den Coniferen, p. 6. Jena, 1869.

the neck to be frequently of two cells (figs. 1 and 2). In one instance I found the lower cell divided by a cross wall, thus making three cells in all (fig. 3). This, however, is exceedingly rare for it was the only case observed out of the large number of ovules sectioned. In Pinus sylvestris the cells of the neck formed two layers instead of one (fig. 4) as stated by Strasburger.[1] Four cells lie in one plane (fig. 4a), making eight cells in the entire neck. At the stage of development represented in fig. 4 the ventral canal cell had not yet been cut off. A very large nucleus lay just beneath the neck while the remainder of the cavity of the archegonium was filled with granular protoplasm staining deeply with alum cochineal and containing many large vacuoles. In figs. 1 and 2 (Tsuga) the archegonium is mature, the ventral canal cell consisting almost entirely of a very large nucleus. The nucleus of the egg-cell occupied a central position. As regards other details in the development of the archegonium, I find them to agree with the account of Strasburger.

Apical growth of the stem.

In the BOTANICAL GAZETTE for January, 1892, Conway MacMillan, in a review of the work of Duliot on apical areas in seed plants, reports that author as concluding that in the gymnosperms the apical growth in the stem proceeds from a single apical cell. Unfortunately I have not had access to Duliot's paper, and do not know what species were studied; but from my investigation upon the stem of Pinus sylvestris the conclusion of Duliot seems to be very hasty at least. The growth in Pinus sylvestris corresponds very nearly with Strasburger's account for *Pinus Pumilio.*[2] A pretty well defined dermatogen layer passes over the entire apex which is relatively very large and cone-shaped at the period of active growth. The dermatogen is sharply defined from the periblem (fig. 5, *pb.*); so also the definition between periblem and plerome is very distinct (fig 5, *pl.*). At the extreme apex, however, the dermatogen cells are very much larger than the others, with very large nuclei. These (*x*, *x'*) I take to be the initial cells. In this specific instance the dermatogen, periblem and plerome can all be traced to one or two large cells at the apex. This condition of things appears in three or four consecutive sections, though with not such great regu-

[1] l. c., p. 13.
[2] Die Coniferen und die Gnetaceen, pp. 327, 328. (1872.)

larity, showing that the apex is relatively broad. Transverse sections taken from the extreme tip show that it terminates in two or three large cells (figs. 6, 7), and it seems to me that we can not say with certainty that there is only one initial cell. Figs. 6 and 7 are consecutive transverse sections taken from the apex. In fig. 7 we have a near approach to what would lead one to regard the large cell, x, which has apparently just cut off a segment, x'', as the initial cell, both from its size and regularity in the arrangement of the cells about it. Yet this does not seem sufficient proof to warrant the conclusion. Fig. 5 is the only instance in which I found such great regularity; in all others the apex terminated in two or three large cells, which may be regarded as initial cells, but all approached nearly that shown in fig. 3.

In the apex of the stem of the embryo taken from the seed of Pinus sylvestris and Tsuga Canadensis, we find the nearest approach to a single apical cell (figs. 8, 9 and 10). It is quite probable that in the young state growth takes place from a single apical cell. In instances like that of fig. 8 this seems quite certain. In the embryo of Tsuga (fig. 10) this also seems to be the case, but in fig. 9 we can not be so positive as to the initial cell. A transverse section from the tip of the stem in a similar embryo shows two or three cells of uniform size (fig. 11).

In view of these facts it seems to me that we can not say that there is a single cell at the apex of the stem of the species under consideration, unless it be in the stem of the young plant, and even then not with absolute certainty.

All material used in this study was hardened in chromic acid (1 per cent.), thoroughly washed, stained *in toto* with alum cochineal or alum carmine, washed and dehydrated; then brought gradually into a saturated solution of xylol and paraffine, then into melted paraffine, imbedded and sectioned with a Minot microtome. The sections were counter-stained on the slide with Bismarck brown.

Indiana University, Bloomington.

EXPLANATION OF PLATE VIII.—Figs. 1, 2 and 3, longitudinal sections showing neck of archegonium of *Tsuga Canadensis; vc*, ventral canal cell. Fig. 4, same of *Pinus sylvestris; 4 a*, transverse section through the neck of archegonium of P. sylvestris. Fig. 5, longitudinal section through the apex of the stem of P. sylvestris; *pb*, periblem; *pl*, plerome. Figs. 6 and 7, consecutive transverse sections of the apex of the stem of P. sylvestris. Figs. 8 and 9, longitudinal sections of the apex of the embryo stem taken from the seed of P. sylvestris. Fig. 10, same of Tsuga Canadensis. Fig. 11, transverse section of the extreme apex of the stem of the embryo of P. sylvestris.

All magnified 175 diameters, except fig. 8, 150 diameters.

Germination of the teleutospores of Ravenelia cassiæcola.

B. M. DUGGAR.

(WITH PLATES IX AND X.)

As far as can be ascertained the publications relative to the morphology of the genus *Ravenelia* have yet given no idea of the germination of the teleutosporic stage. From results of anatomical studies in 1886, Parker[1] concludes that the structure of teleutospores is really that of a cluster of fused teleutosporic stalks. Cunningham[2] gives an interesting exposition of the development of the successive forms in two East Indian species, and also traces the development of teleutospores. He shows that the cysts are essentially modified basal cells of the true spore cells, and their origin is illustrated. He makes clearer the relation borne to other members of the group of Uredineæ. However, his attempts at artificial cultivation of teleutospores proved failures,[3] and he is not positive as to the success of experiments relative to the artificial infection.

In the biological laboratory of the Alabama Polytechnic Institute, and under the direction of Prof. Geo. F. Atkinson, artificial cultures have been made with some successful results. Inasmuch as the designation teleutospore involves the idea of the production of promycelia and sporidia, we can expect results to be only of generic importance.

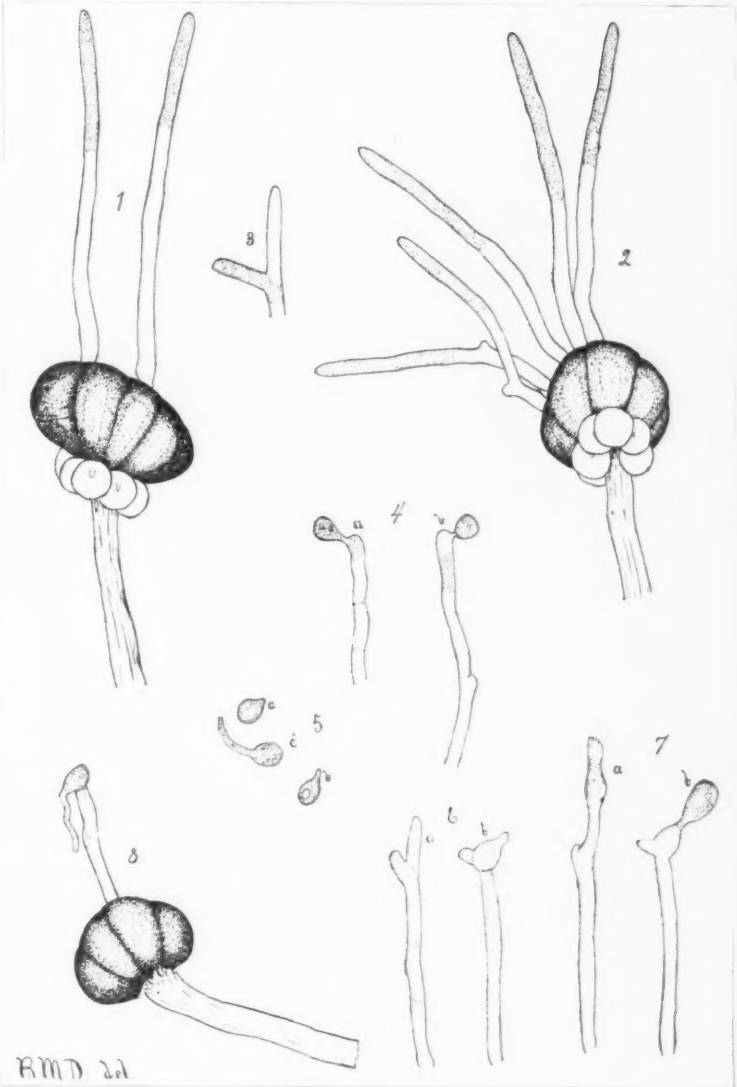
Since the genus is not as well known as its relatives, it may be well to observe some of the specific characters of *R. cassiæcola* Atkinson,[4] which I draw largely from the author's description. The teleutosporic form occurs most abundantly on the stems of the host plant, *Cassia nictitans*; yet it also attacks pods and leaves. The sori are usually irregularly oblong and very dark in color. The teleutospores are more or less brown, composed of from three to thirty somewhat wedge-shaped cells, the width of the head being usually from 50 to 90 μ. The compound colored pedicel is from 10 to 18 μ wide, and the length generally about 80 μ, yet it may be twice

[1] Morphology of *Ravenelia glandulæformis*. Proc. Am. Acad. of Arts and Sci., vol. XXII.

[2] Notes on the life history of *R. sessilis* B. and *R. stictica* B. & Br. Scientific Memoirs by Medical Officers of the Army of India.

[3] Cooke, Journ. Royal Mic. Soc., vol. III, p. 389, says: "The utmost that we have been able to accomplish has been to obtain single short germinating threads from the apices of a few of the pseudospores in *R. aculeifera*."

[4] Described in BOTANICAL GAZETTE, Nov., 1891, as "A new Ravenelia from Alabama."



DUGGAR on RAVENELIA.

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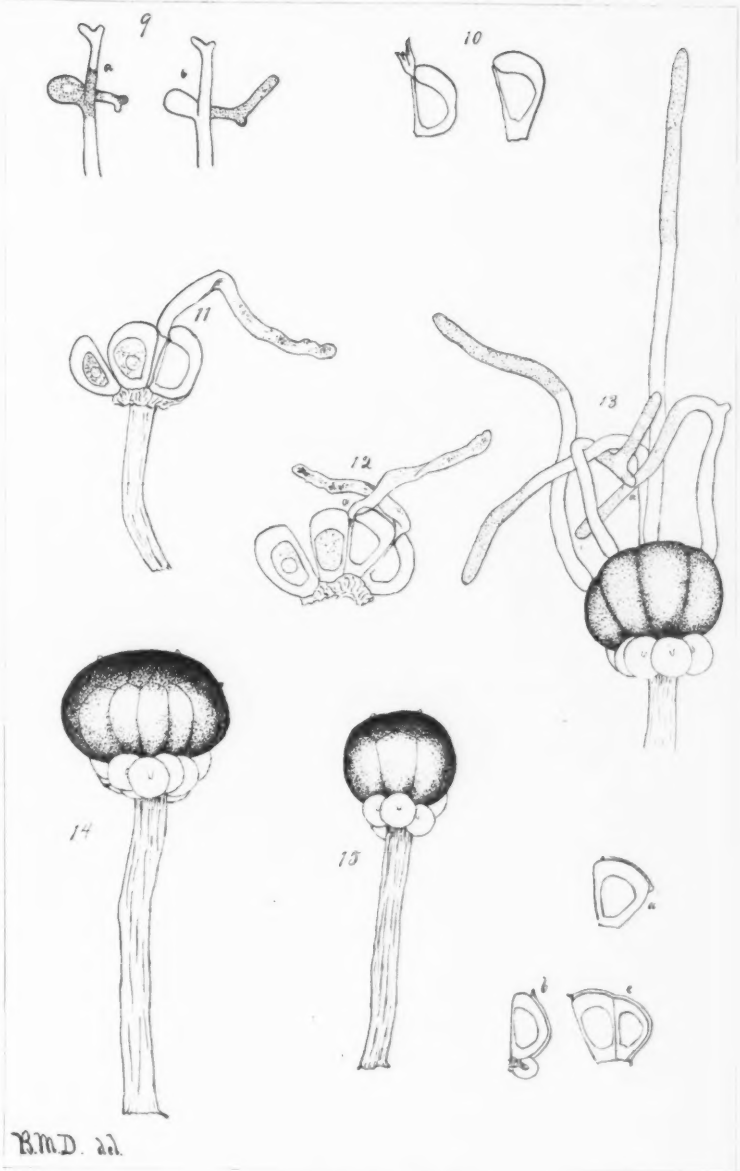

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as long. At the junction of the pedicel with the spore cells we observe the characteristic cyst cells. These are hyaline or slightly colored, usually spherical, and average about 12 μ in diameter (for normal spores see figs. 14 and 15).

After remaining in water for some time, maceration of the spores is to a certain extent effected, and by slight pressure the individual cells are easily separable for examination. It is then apparent that *R. cassiæcola*, so far as the arrangement of cells is concerned, belongs to the division as noted by Parker of which *R. Indica* is the type; consequently the cells are only laterally coherent. Besides the close union of adjacent cells, there is an external coat common to all which holds them together more firmly. In thickness, this is less than the exterior walls of individual cells (fig. 16), and from its surface often appear short, hyaline or slightly colored spines.

Specimens of the host plant containing the fungus in good condition were collected early in December, after the death of the vegetation. Water cultures, both slide and cell, then manifested no germination after being observed for a number of days. To continue the preservation of the material as in a natural state, it was simply "heeled in" under a box in an exposed place, and it was from this material that results were finally obtained. Slide and cell cultures with both distilled water and sugar solution were failures early in January, but on Feb. 23 the first results were secured. This occurred only in the sugar solution, and nine days after the spores had been sown. The results here given are from the same. It may be of interest to note that well-dried herbarium specimens have germinated after remaining three weeks in a cell culture with water.

The promycelia issue about perpendicularly to the plane of cells, bending towards the upper surface in an abundance of the medium, and when the spore lies on its side. Until a little greater than the length of the head, they are observed to be simple tubes completely filled with protoplasmic contents. These tubes rapidly elongate, the protoplasm collecting in the distal extremity, and they become finally from two to five times the length of the head (figs. 1 and 2). A promycelium may become branched, usually when meeting an obstruction to its growth, and this may be nearly at right angles to the former course (fig. 3). In all cases, however, the protoplasm remains separated only a short time, rapidly

collecting in the growing extremity. Apparent septa are sometimes observed (fig. 4 *a* and fig. 6 *a*), but the deception results from a coherence of granular contents in a cross section of the tube; and by moving towards the point of growth, this protoplasm soon mingles with the mass at the normal location (fig. 7 *a*). Variations of the above may be found in the empty spaces sometimes noticeable (fig. 13, *a*, etc.), and these are most abundant after a considerable growth has taken place. Small vacuoles are not infrequent.

The sporidia are developed at or very near the terminal portion of the promycelia (fig. 4, *a* and *b*). The first evidence of this formation is shown by a part of the protoplasm collecting into a side branch, whose connecting portion is but little smaller than the main tube, and which assumes more or less the usual characters of a sterigma. With this development of sporidia a more highly refractive power is manifest. A sporidium measures about 9 μ in diameter, but its form is not generally spherical. In most cases the abscised reproductive body shows a prolongation at the end by which it was attached (fig. 5 *a* and *b*), the constriction which eventually sets the body free encroaching somewhat on the usual limits of the sterigma in the group of Uredineæ. Vacuoles are frequently present, but these vary in number and in size.

Sporidia are not always produced, and their absence is counterbalanced by a longer growth of the tubes. This greater growth probably results from the fact that the promycelia are completely immersed in water. Lagerheim[5], speaking of the germination in water of *Puccinia heterogena* Lagerheim, says, "They then germinate exactly like uredospores; a long non-septate germ tube, often bent backward and forward, and with a strongly undulating contour, grows out of the germ pore. . . . Probably the fungus can reproduce itself by these germ tubes, which, because they form no sporidia, penetrate directly into the leaf." It is possible that under favorable conditions the same may be true for the long promycelial growths of the fungus we are considering. A promycelium often shows an enlargement at the end, as if a terminal sporidium were to be produced, but instead, the tube may be again normally continued. With the above character, a geniculation is often noticeable, the new growth

[5] Journal of Mycology, vol. VII, no. 1.

resulting in the protrusion of the wall in an oblique direction; or the latter character may exist independently of the former. A peculiar instance is shown in fig. 9, *a* and *b*, where a sporidium seems to be almost fully developed laterally, then its wall is protruded from near its base into a new tube which again branches. It seems that a promycelium bears only one of these reproductive bodies, as more than that number have not been observed; still this cannot now be positively asserted. The true development of the promycelia is often interfered with on account of parasitic attacks. Owing to the large size of the spores of this fungus, they carry many adhering germs into the cultures, and the tender promycelial tubes are favorite spots for bacterial growth. It appears that the germination of a sporidium is by the prolongation of the pedicel-like end of attachment (fig. 5, *c*).

If the cells of a germinating teleutospore are separated by gentle pressure under a cover glass, the emergence of the promycelia from the germ pores can be noted. In the peripheral cells, which are externally somewhat convex, the germ pore is situated at the upper and inner extremity (fig. 10), while in the more angular central cells it may be at any distal corner (fig. 12, *a*). In all cases it is marked by the junction of the thick external cell wall with the thinner wall separating individual cells. The germ pore can be more distinctly seen by the usual examination with sulphuric acid.

In Ravenelia cassiæcola only has the germination of teleutospores thus far been observed, but these notes serve to indicate that the germination is generically characteristic. It differs from that of such typical genera as Puccinia, etc., in the non-septate character of the promycelia, except in such species as P. heterogena above mentioned, where the germination takes place in an abundance of water. "In *Coleosporium*," says Plowright,[6] "each cell produces a single promycelial spore," and from his illustration of *C. senecionis* we observe that the tube which bears this sporidium tapers gradually to a very small size. Now if we deem both promycelium and sterigma essential terms, it is difficult to differentiate their limits in such cases. Sorauer[7] only states that each cell develops a simple promycelium with a sporidium. De Bary[8] defines

[6] British Uredineæ and Ustilagineæ, p. 45.
[7] Pflanzenkrankheiten, 2te Aufl., II, p. 244.
[8] Morphology and Biology of the Fungi, etc., p. 281.

the character of producing a single sporidium as peculiar to Coleosporium, but he names the entire tube from which this body is abscised a sterigma. Since the term sterigma is more or less broad, we may regard *Coleosporium* as possessing a truly non-septate promycelium, and still the above details will perhaps make clear the essential modifications in R. cassiæcola and probably the general features in the germination of the genus Ravenelia.

Polytechnic Institute, Auburn, Ala.

EXPLANATION OF PLATES IX AND X.

PLATE IX.— Fig. 1, germinating teleutospore, showing normal condition of promycelium. Fig. 2, same as above with a slight geniculation and rudimentary branching. Fig. 3, a promycelial branch almost at right angles to the former course. Fig. 4, *a* and *b*, stages in the development of sporidia; *a* also shows apparent septa. Fig. 5, *a* and *b*, sporidia; *c*, sporidium germinating. Fig. 6, *a* and *b*, abnormal conditions of promycelia. Fig. 7, *a* and *b*, same as fig. 6, but representing appearances on following day. Fig. 8, teleutospore with single promycelium and abscised sporidium germinating while still in the vicinity of its point of production.

PLATE X.— Fig. 9, *a* and *b*, peculiar development of a promycelium noted on successive days. Figs. 10, 11 and 12, representing cells separated by pressure, and showing the location of the germ pores and the emergence of the promycelia. Fig. 13, teleutospore germinating, but so surrounded by other spores that the promycelia are modified. Figs. 14 and 15, normal teleutospores of different number of cells. Figs. 16, *a*, *b* and *c*, individual cells, showing relative thickness of cell walls and the common external coat.

All figures were drawn under camera lucida.

Notes on Carex. XVI.

L. H. BAILEY.

An unusual amount of carex material has come into my hands within the last year, bringing a number of new species, extending the ranges of well known species to an important extent, and affording data for the clearing up of old doubts. These specimens have come from almost every part of North America and from very many collectors; in fact, the carex flora of the country has never had so many friends as at present. Some of the most important facts concerning the geographical distribution of species are recorded below.

Carex obesa All., var. *minor* Boott, heretofore not known south of Saskatchewan, was collected last July upon high bluffs at South Fowl Lake, Northern Minnesota, by F. F. Wood.

C. Torreyi, the rarest of the eastern carices, was found in abundance upon a small area in 1890, in the suburbs of Minneapolis, by J. H. Sandberg. This species was reported from New York and Pennsylvania a half century ago, but has never been rediscovered within Gray's Manual region until the present finding. It occurs in Colorado and in British America, and its reference to New York and Pennsylvania is probably an error. The original specimens were found in a European herbarium mixed with *C. pallescens* from New York and Carlton House, British America.

C. Tuckermani, reported no farther east than western New England, has been found at Kineo, Moosehead Lake, Maine, by Dr. G G. Kennedy.

C. chordorhiza, not known east of Vermont heretofore, is sent from Orono, Maine, by M. L. Fernald.

C. laxiflora var. *divaricata* has been collected at Natural Bridge, Virginia, by J. R. Churchill.

C. hystricina var. *Dudleyi* was found growing quite abundantly in a low place at Owosso, Michigan, by G. H. Hicks. This is the fourth station for the plant.

C. cephaloidea, not known east of western Massachusetts, where Dewey first found it, is now found in York Co., New Brunswick, by Mr. Brittain.

C. trichocarpa var. *Deweyi*, is sent from Ames, Iowa, by Professor A. S. Hitchcock. It has been known in the Manual region only from Dakota.

C. distans Linn., a European species, was found in ballast in Philadelphia, in 1877 and 1884, by I. C. Martindale. Mr. Martindale also found at Atco, N. J., in 1876, the true *C. flava* var. *Œderi* Lilj. This is the only finding of this plant in America, so far as I know. *C. panicea* is sent from Sellersville, Penn., by C. D. Fretz. This species, while very thoroughly established in some parts of Massachusetts, does not appear to extend itself rapidly into new regions.

Since the separation and proper delineation of *C. deflexa* and *C. Novæ-Angliæ*, these species have been sought and they are found to be more frequent than the Manual record indicates. *C. deflexa* is not confined to "high mountains," having even been found in a low sandy pasture on the banks of Great Works River, S. Maine, by John C. Parlin. It is also sent from the Keweenaw peninsula, Northern Michigan, by O. A. Farwell. *C. Novæ-Angliæ* is frequent at Mt. Desert, and

Edwin Faxon sends a fine suite of specimens from the White Mountains: from Profile Lake and Bald Mt., Franconia Notch; White Mt. Notch near Willey House; woodland cleared of trees, between Fabyan's and base of Mt. Washington; summit of Mt. Willard. It is strange that this well marked species should have been so long overlooked.

Three species are added to the Manual region from Nebraska: *C. Nebraskensis* Dewey, from Anselmo, Custer Co., and Hot Creek Basin, Sioux Co., by H. J. Webber. This is the first time the species has been found within the present limits of Nebraska. *C. Douglasii* Boott, Anselmo, Custer Co., Webber. *C. marcida* Boott, Anselmo and Broken Bow, Custer Co., and Thedford, Thomas Co., Webber; Alliance, Box Butte Co., G. D. Swezey.

C. canescens var. *dubia* Bailey, which has been one of the most obscure forms of a perplexing species and which has been known only from one collection in the Uintah Mountains and another in the Wahsatch, is now represented in my herbarium by good specimens from the Blue Mts. of Eastern Oregon (Cusick), Skamania Co., Washington (Suksdorf), and Tulare Co., Cal. (Coville, 1506 Death Valley Expedition). It proves to be well defined.

Among the novelties, the following appear to be supported by sufficient evidence:

C. herbariorum n. sp.—One of the FERRUGINEÆ allied to *C. ablata* and *C. luzulæfolia*: tall and slender (2 ft. or more?), smooth throughout; leaves broad ($\frac{1}{4}$ or $\frac{3}{8}$ in.), thick and stiff and apparently half evergreen, long; staminate spike single, an inch or two long, on a stalk of about its own length, rusty, the scales nearly linear and pointed; pistillate spikes 3 or 4, approximated near the top of the culm, erect, an inch or so long, evenly cylindrical, rather loosely flowered, rusty, on stalks once or twice their own length and springing from loose sheaths about an inch long which are tipped with an awn-like projection of similar length; perigynium medium or below in size, lanceolate, prominently excurved at maturity, strongly nerved and 2-toothed, smooth, about the length of the ovate and pointed brown-margined scale.—A well marked species with perigynia reminding one of the interesting VIGNEASTRÆ section. Habitat unknown. The species was found in a miscellaneous batch of nondescript carices from Herb. Olney (Brown University), without date, locality or

collector. Since the determination of the species, James L. Bennett, of Brown University, writes that the plant was collected by Wheeler's Expedition West of the 100th Meridian. In Wm. Boott's report upon the carices of this expedition there is nothing to suggest this species.

C. Pringlei n. sp.—One of the PALUDOSÆ, not closely allied to any American species, but coming nearest, perhaps, to *C. riparia:* tall, stiff and stout (four to six feet high), pale throughout, the culm obtusely angled and smooth; leaves stiff and long, rough on the edges and sometimes on the keel; staminate spikes three or four, an inch or two long or the terminal one twice longer, cylindrical, scarcely stalked, the bases enveloped by a scarious bract, the scales of the spikes linear and membranaceous with a somewhat expanded tip which is more or less jagged and provided with a short cusp; pistillate spikes three to six, all approximated or aggregated, heavy and densely flowered, two to four inches long, sessile and erect, their bases subtended by an expanded and long-pointed bract; perigynium long-linear-elliptic or linear-ovate (about four lines long), thin and flat, the small and stipitate three-angled achenium lying nearly in the center, faintly few nerved, beakless, the orifice entire or slightly sulcate, the lower portion smooth, but the upper part sparsely hairy, about the length of or slightly shorter than the strong-pointed or even awned rough scale.—A coarse bushy-spiked species with something the look of *C. spissa;* collected August 4, 1891, on borders of pools and streams in alkaline meadows one hundred miles east of the city of San Luis Potosi (Hacienda de Angustura), Mexico, by C. G. Pringle (No. 3801).

C. xerantica n. sp.—Group OVALES, between *C. pratensis* and *C. fœnea*: differs from the above species in its short erect silvery-white head, and broader, much firmer and nerveless perigynium. It is a tall and very stiff species with a stramineа-like aspect, and dry appearance. It was collected at File Hills, British America (104° longitude, and $50\frac{1}{2}$° latitude), by John Macoun, July 4, 1879, and at Moose Jaw, about thirty miles west and forty south of File Hills, by the same collector July 18, 1880, in both of which stations it was rather abundant. I have endeavored for a number of years to refer this perplexing plant to some of its neighboring species, but the attempt is always unsatisfactory. Its characters are constant in a good suite of specimens, and it appears to merit specific distinction.

C. Montanensis n. sp.—Belongs to the RIGIDÆ and is allied to *C. Tolmiei*, although it has much the habit of the PENDULINÆ (as *C. Magellanica*): a foot or a foot and a half high, in tough clumps, the culms weak at the top and mostly nodding, somewhat overtoping the flat and rather soft narrow (1½ to 3 lines wide) leaves; staminate spike single, about a half inch or less long, ovate or ovate elliptic, brown-purple, on a short and weak stalk, the scales thin and mostly blunt; pistillate spikes three to five, borne at the top of the culm and drooping or nodding on slender stalks, from one-half to three-fourths of an inch long, dark colored, the lowest bract leafy and about equalling the culm; perigynium ovate, soft, nerveless (entirely lacking in the granulated character of *C. Magellanica* and its allies), terminated by a short and very slightly toothed beak about the length of but broader than the black-purple blunt scale; stigmas two or three.—Montana, Upper Marais Pass, W. M. Canby, Aug. 2, 1883 (no. 350), and along subalpine streams, Park County, Frank Tweedy, Aug. 5, 1887. Also on mountain slopes, Kootanie Pass, Rocky Mountains of British America, John Macoun, Aug. 9, 1883. I have at different times referred this plant to *C. atrata* var. *ovata* and *C. Tolmiei*.

C. bella n. sp. (*C. atrata* var. *discolor* Bailey).—This beautiful plant appears to have no immediate connection with *C. atrata*, and when I first referred it to a variety of that species I thought that "it is not improbable that it is specifically distinct from *C. atrata*" (Journ. Bot., Nov. 1888). It is more closely allied to *C. Mertensii*. It is a slender plant, about two feet high, the culms surpassing the flat and long pointed leaves; spikes 3 or 4, the terminal one prominently staminate below and the others usually bearing more or less staminate flowers at the base, all approximated, the lowest one or two drooping on very slender peduncles and the upper ones sessile or nearly so, all narrowly cylindrical (about 1 in. long), compactly flowered, the whitish perigynia contrasting forcibly with the purple scales; perigynium ovate, whitish, thin and somewhat inflated, nerveless, abruptly contracted into a very small straight beak which is very lightly toothed or simply erose, much broader and mostly a little longer than the purple sharp pointed scale.—Mountains, Colorado, Utah, and Arizona.

C. varia Muhl. var. **australis** n. var.—Stoloniferous; spikes all distinct or at least not aggregated, the lowest one often entirely separated from the rest, all usually longer than in the species itself; staminate spike straight and conspicuous. Tupelo and Starkville, Mississippi, Tracy; Houston, Texas, Nealley; and Hockley, Harris Co., Texas, Thurow.

C. aquatilis × stricta. A pronounced hybrid between these species has been found in some quantity at Orono, Maine, by M. L. Fernald. The hybrid is fully as vigorous as *C. aquatilis*, and is glaucous, but the perigynia and scales are stricta-like, although the spikes are large and thick, as in *C. aquatilis*.

Material wanted.—A carex which is said to produce good pasturage is reported to grow in Louisiana, but I have not been able to secure good specimens of it. I have obtained a bunch of the dry leaves and some loose perigynia from a correspondent in Grant Parish, central Louisiana, and I am not able to place the specimens with any species. It appears to be undescribed. My correspondent writes me as follows: "The plant grows here in the forest upon alluvial lands upon certain portions of the Red River bottoms. Near me are 500 or 600 acres covered with it upon which numbers of cattle and horses winter. It grows as thick as any grass, and not in bunches here and there, making a perfectly green and firm covering four to eight inches high." Unfortunately, my correspondent is not a botanist, and an expert witness is wanted to determine if all this pasturage is really a carex; and I desire good specimens of the plant for determination.

Our common *Carex echinata*, with its varieties, is in need of revision, and I shall be glad of any specimens which will throw light upon its variations.

Cornell University, Ithaca, N. Y.

An automatic device for rolling culture tubes of nutrient agar agar.

GEO. F. ATKINSON.

(WITH PLATE XI.)

Rolled culture tubes of nutrient agar agar are so convenient for the separation of many micro-organisms, and are employed by so many investigators for the study of the growth and conformation of colonies that any device for rolling them successfully is worthy of note. Especially is this the case when such device is, under certain circumstances at least, an improvement over the present methods in use.

The device introduced by Esmarch of spinning the tubes on the surface of ice water while a rubber cap covered the cotton plug was improved upon by Dr. Booker, of Johns Hopkins University by spinning them in a groove upon a block of ice.[1] This is an exceedingly satisfactory method. There is one difficulty encountered, however, which in many cases varies from a trifling to a very serious matter, according as ice is obtained with comparative ease or great difficulty. Those who are fortunate enough to be located in centers where trade demands for ice provide a constant supply, encounter simply a trifling expense and the little attention necessary to obtain the supply needed. Many institutions and workers, however, are so situated that it is almost impossible during the winter months to obtain ice without going to great expense, and many times during any season of the year the trouble alone of providing it is no small annoyance.

Being so situated myself I have given my attention to devising some means of rolling the tubes with precision by making use of the water supply commonly provided for in laboratory fittings. It is possible with a stream of cold water from a faucet to so hold with the hands and revolve a tube as to distribute and fix the nutrient agar in a thin and tolerably even film. But many failures result and at best the tube is far inferior to one rolled on ice.

Recently I have made an automatic device for rolling the tubes under a continuous shower of cold water as perfectly and regularly as it is possible to do on ice and with far less trouble even though a constant supply of ice is within easy reach.

[1] Mead Bolton: Schizomycetes, etc. Reference Handbook of Medical Sciences, vol. VI.

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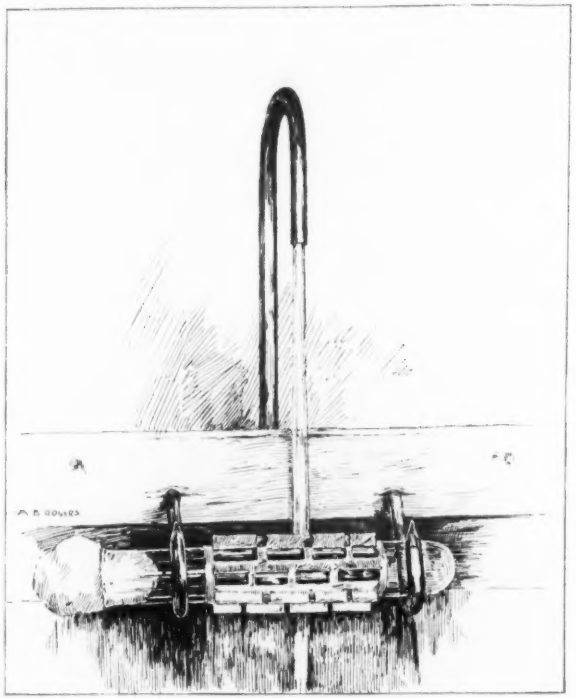

FIGURE 2.—Culture tube at rest.

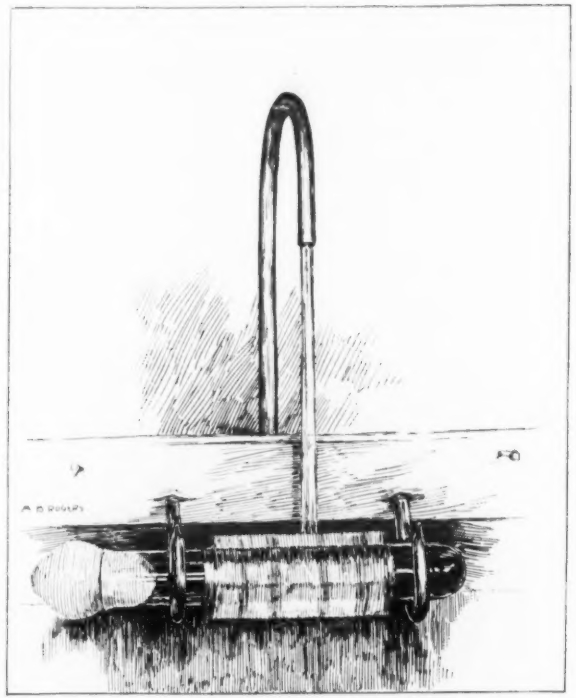

FIGURE 3.—Culture tube in motion.

It consists of a tin jacket, with rectangular perforations and bristling with "paddles," which grasps the tube and upon which the stream of water is so directed that it furnishes not only the motive power for whirling the tube but also the cold bath to solidify the agar agar. This device, quiet and in motion, is shown in figures 2 and 3 in plate XI.

The jacket I made in about an hour's time. It is quickly and easily slipped from one tube to another. The frame work which rests across the edges of the sink and holds the supports for the tube was the work of a few moments. The

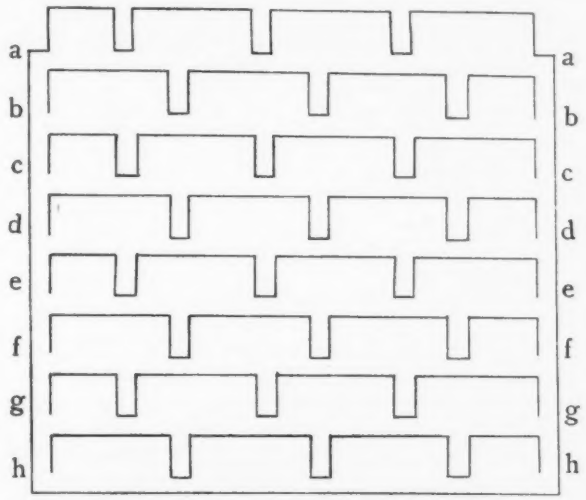

FIGURE 1.—Outline of jacket for rolling culture tubes. Full size.

jacket was made from a single piece of tin as follows: The tin was first cut the exact size of figure 1, three edges being straight while one edge was cut as shown in the figure. Now placing the sheet of tin upon a block of wood, with a quite narrow sharp chisel cuts were made corresponding to the irregular lines *b b*, *c c*, etc. The sheet was then placed in a vise down to *a a*, and the four rectangular projections bent perpendicularly to the sheet in the same direction that the chisel was driven. The sheet is then raised to the line *b b*, and so on until all the small rectangular pieces are bent out to

ATKINSON on a DEVICE FOR ROLLING CULTURE TUBES

serve as paddles; the spaces serve to admit the water upon the tube.

The sheet is now bent around a cylinder of a somewhat less diameter than the test tubes to be used. This gives the jacket a tension which enables it to grasp the tube firmly. By erecting the paddles in a direction corresponding to the cut of the chisel, the inner surface of the jacket is left smooth and does not scratch the glass in slipping it on or off.

For the support of the tube while under the shower bath I used two ceiling hooks which I screwed into a narrow board long enough to rest across the sink. They should be so levelled that the end of the tube containing the cotton plug will be very slightly elevated. The rapid motion will prevent the agar from gravitating down the tube while water will not run on to the plug.

In rolling the tubes the frame is drawn a trifle forward so that the stream of water passes in front of the frame, but just behind where the tube will rest. So soon as the tube is lifted from the warm water bath the jacket is slipped on, the tube then held horizontally, while the liquid agar is first distributed evenly in the usual way. Place it immediately on the supports as shown in figure 2, plate XI, then quickly slide the frame backward so that the water strikes the paddles when the tube immediately revolves as shown in figure 3, plate XI. The supports must not pinch the tube in the least else the friction will interfere with the freedom of the revolutions. The jacket and frame when not in use should be kept dry to prevent rust.

A little practice will determine the proper distance for the jacket from the end of the tube. It is best to have it a little nearer the bottom end of the tube and to allow the stream of water also to strike somewhat nearer the corresponding end of the jacket. This lessens the danger of wetting the cotton plug. As I have arranged mine, when running very rapidly the plug is kept dry.

In making the jacket due regard should be had for the size of the tube to be rolled. Within certain limits tubes of different diameters can be rolled with the same jacket since its elasticity permits some variation in its accommodation to the tube.

Alabama Polytechnic Institute, Auburn.

Noteworthy anatomical and physiological researches.

Gases in massive organs[1].

While this paper does not contribute very much that is new it is interesting as a careful record of experiment and as a verification of earlier researches. The author has availed himself of the more recent method of gas-analysis and brings out some interesting points, particularly regarding the pressure of internal atmospheres in plant-organs. In general his method is to produce an artificial chamber by perforating the fruit or tuber or root to be observed and in the *lacuna artificielle* thus produced to insert a tube, with the lower end sunk in a mercury-bath from the upper portion of which tube, as needed, a little gas can be taken for analysis. In this way it is possible to have under one's eye the changes that may take place and the differences, if any exist, between the internal and the external air are clearly distinguished. Potato-tubers and several fleshy fruits, those of various gourds and Rosaceæ, were studied with much care and an effort was made to discover not only the nature and pressure of the inclosed gases but to determine in what way these gases were distributed through the tissues, whether by diffusion, effusion (the movement through small channels) or by dialysis through membranes. Some of the general conclusions may be briefly transcribed here to indicate better the scope and extent of the researches.

1. The internal atmosphere of fleshy or massive organs is generally marked by a notable increase over the surrounding air in the proportion of oxygen, a feeble proportion of CO_2 and a slightly different proportion of nitrogen, which sometimes exceeds that in the outer air and sometimes does not, but is always rather close and slow to vary. 2. The internal pressure is almost always different from that of the outer air. Sometimes it is negative and sometimes positive but always in inverse proportion to the nitrogen. 3. The oxygen tends to be distributed through pores (effusion), but the CO_2 tends to be distributed through membranes (dialysis). 4. Humidity acts upon a massive organ in such a way as to increase its permeability while diminishing its porosity, and this is reflected in the changes in the pressure and composition of the internal gases. It tends therefore to a purifying of the air, in most cases, by the accumulation of oxygen and the throw-

[1] H. Devaux :— Ann. Sci. Nat. Botan., Ser. VII, xiv, 297–395.

ing off of CO_2. 5. Dessication acts in the reverse manner and, by diminishing the permeability, decreases the oxygen and tends to the storing up of a greater proportion of CO_2. 6. The nitrogen is passive and is carried as a by-product with the others. 7. The general conditions of gaseous interchange between fleshy plant structures and the rest of the plant or the outer air are best understood when we fix our attention upon the undoubted fact that there are three different kinds of interchange going on simultaneously, each of which is capable of modification by external or internal conditions. These are diffusion, effusion and dialysis.—CONWAY MACMILLAN.

Effects of electricity on growth.[1]

In this paper Hegler has described the effects of electricity on the growth of plants. In it he has shown that certain plants respond to electrical stimuli in a similar manner as they do to light. In his experiments he used an apparatus like that used by Hertz. Hertz has already demonstrated that electricity presents quite the same phenomena as light; that the electric beam can be polarized, focused, reflected and refracted.

The apparatus consists briefly of four Bunsen elements, which are connected by an interrupter with a very large induction apparatus, consisting of many thousand feet of coil; from this the current is transmitted to two brass knobs of 1.5 cm. radii, which constitute the poles, and between which the electric spark is made to pass at regular intervals. The brass knobs are placed about 10 cm. apart in a vertical direction, so that the transverse electrical waves fall on the long axis of the plant which is situated 1–2 cm. from the electric spark.

For these experiments Hegler found the rapidly growing aerial hyphæ of *Phycomyces nitens* particularly well adapted, as it is well known that they are exceedingly sensitive to all external influences. The plants were cultivated on sterilized bread and covered with a black paper cylinder to prevent heliotropic bendings. He found in from 3 to 6 hours the hyphæ bend away from the electric source, from which he maintains they are negatively electrotropic. The angle of bending, however, he found somewhat smaller than that produced by intense light. Herr Hegler also experimented with reflected rays, both from a plain and parabolic metal reflector, from which he obtained similar results.

[1] ROBERT HEGLER:—Ueber die physiologische Wirkung der Hertz'schen Electricitætszellen auf Pflanzen. Leipzig.

When a cylindrical wire gauze was placed over the plant the hyphæ made no bendings, although a bell glass made no difference at all in their response to the electrical stimulation. — GEO. E. STONE.

The vegetation of the paramos of Venezuela.[1]

This paper contains a general sketch of the vegetation of the paramos with reference to the distribution and appearance of certain plants, and an account of the biology of these xerophilous plants.

Some of the Compositæ are characteristic of the paramo vegetation. Transpiration is diminished in these plants in different ways; for instance, by a dense cover of woolly hairs, by the development of coriaceous leaves, sometimes small in size and with involute margins, or by the development of merely short stems with densely leaved rosettes and underground reservoirs of nutritive matters. These characters are not, however, strictly separated, for more than one may be observed upon the same plant. Several other families besides the Compositæ show the same peculiarities.

The leaves of *Espeletia* have an immense cover of long white hairs, which are bent into broad spirals, so as to form a layer many times thicker than the leaf-blade itself. Thus the plant is well protected against a too rapid change in temperature, against the exsiccating effect of the winds, and has at the same time gained control of the transpiration. The leaf has a distinct hypoderm, which probably serves as a water-reservoir, and the inferior face shows several longitudinal ribs, which border on corresponding cavities in the leaf-blade. The chlorophyll-bearing parenchyma covers the furrows between the ribs, and there are in the interior part of the leaf wide openings, which remind us of lacunes, but which are covered with hairs and provided with stomata. These openings have been formed merely by a turning inwards of the surface of the leaf-blade. Of other paramo-plants with similar covering of hairs are mentioned a *Plantago*, a *Lupinus*, and especially the remarkable *Jamesonia nivea*. This last shows an aspect widely different from other ferns; the pinnules are horizontally spread out and cover each other as closely as the coins in a roll.

[1] K. GOEBEL:— Die Vegetation der venezolanischen Paramos. Pflanzenbiologische Schilderungen, Pars 2. Marburg 1891.

Protection secured by diminishing the leaf surface is especially marked in a grass, *Aciachne pulvinata*. The blade is so strongly involute that the stomatiferous superior face is a mere furrow. The cells of the inferior epidermis are very thick walled and there are three layers of sclerenchyma inside the epidermis, all around the blade.

In some other plants the leaves are awl-shaped with the aspect of conifers or lycopods; such forms were observed in *Hedyotis nitida* HBK., which belongs to the Rubiaceæ; in *Lysipomia* of the Lobeliaceæ; and in *Phyllactis* of the Valerianaceæ; in species of *Alchemilla* and others.

There are, however, other peculiar forms of paramo-plants, which can not be arranged under any of the three above named groups; for instance some Umbelliferæ with leaves like those of a *Juncus*, namely *Ottoa*, *Crantzia*, etc.

Although these paramo-plants show the so-called xerophilous structure, the author calls attention to the fact, that a similar structure is also known in plants which do not belong there, but inhabit widely different localities. We therefore cannot always depend too much on structure in determining the character of the locality, because anatomical structure in this instance merely shows that the individuals live in a climate where a protection against transpiration has become necessary. This special vegetation seems to have been forced into its present shape for defence against stormy winds rather than extreme heat.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.—(See p. 124 *ante*.) Correction must be made regarding the name recognized. There is an *Asclepias auriculata* Kunth. So Engelmann's *Asclepias auriculata* is not tenable. Dr. Gray's name, *Asclepias stenophylla*, must therefore stand. I hasten to make this correction, the more since I hesitated at the time in following the dictum that "the oldest available specific name" must stand. It seems to me, from this present experience, that to take up "the oldest available specific name *in the right genus*" is safer and less liable to reconsideration.—J. M. HOLZINGER, *Washington D. C.*

The embryo-sac of the Metaspermæ.— Hartog in the Dec. 1891 number of the *Quarterly Journal of Microscopical Science* suggests that the eight cells in the embryo-sac of the Metaspermæ are all to be considered as reproductive and follows the later view that the endosperm nucleus is a zygote. In a foot-note he retracts this position, in consequence of Guignard's work on the embryo-sac of *Lilium*. The writer a short time ago sent to the GAZETTE a statement of the same position as that first maintained by Hartog; but upon seeing his paper the preliminary note was withdrawn. In view of my own observation I am not, however, inclined to withdraw with Hartog from what seems to me the clear fact that the embryo-sac is, wherever we meet it, a *megaspore*. I do not think that the results of Guignard at all prevent us from holding to the view that the cells within the embryo-sac are, in Archispermæ and Metaspermæ alike, a female plant. At a later time I hope to discuss this point. In this brief note attention is directed to one fact which has escaped the late investigations, I believe. It is this: in the embryo-sacs of *Narcissus poeticus*, *Portulaca oleracea*, and *Cucurbita pepo* the micropylar nucleus, that is the sister nucleus of the egg, stains as does the *sperm* nucleus from the pollen-tube of the same species. The antipodal nucleus that fuses with this micropylar nucleus to form the definitive nucleus stains as an *egg*. That is to say, the micropylar nucleus stains about twice as quickly as the antipodal in both methyl-green and safranin. It has numerous, deeply stained chromatin bodies (chromosomes or chromatomeres) and the nucleoli are of a greater number than in the antipodal nucleus. In a number of other ways that might be named the antipodal nucleus reacts as an egg while the micropylar nucleus reacts as a sperm. It is clear that this can be explained either upon the hypothesis of Weissmann that the micropylar nucleus is histogenic, upon that of Hartog that it is an arrested gamete, or, best of all, upon that of Minot, Balfour and Van Beneden, that it is the male substance thrown off as a polar body and to make room for the similar but more distant substance of the sperm-nucleus. It is therefore improper to say as Hartog does that the definitive nucleus is a zygote, for there is a clear morphological distinction (that of size), beside the physiological one given, between the two fusing nuclei. Undoubtedly this fusion is a sexual act and the antipodal nucleus after it has been fertilised is enabled to pass into the segmentation phase and actually builds up a body, the endosperm, which is, however, always dependently situated with regard to the more virile, cross fertilised, embryo-producing egg-cell. The views of Warming, Mann,[1] Vesque, and Guignard, or the later view of Hartog, that these cells are any or

[1] See BOT. GAZETTE, this vol., p. 104.

all of them spores or the homologues of spores, seem to draw little support from the fact recorded. It is well said though by Hartog that the whole eight-cell group should be considered as egg-organs and not in any part as prothallium. I made this point in the note that was withdrawn, from a consideration of the staining phenomena mentioned above, and it seems not unlikely that it will be supported. It is very evident that the endosperm of the Metaspermæ is a different structure from that of the Archispermæ. It is probable that the two types are to be referred to different generations, that of the Archispermæ to the gametophytic and that of the Metaspermæ to the sporophytic.—CONWAY MACMILLAN, *University of Minnesota.*

A bit of the flora of Central Arizona.—During July and August of last year I was collecting plants and studying the flora of Central Arizona. While *en route* for Camp Verde by the old Black Cañon stage route between Phœnix and Prescott, I stopped for two days at Big Bug. This is a small mining camp and stage station some eighty miles north of Phœnix. During my sojourn here, I found in a deep cañon several miles northwest of the station as interesting a bit of flora as I have seen since coming to the territory.

As we leave the flat sandy desert, which extends for some distance north of Phœnix, and enter the mountainous region, there is almost an entire change in the floral aspect of the country. At this season of the year the only conspicuous vegetation on the sandy mesa that could be observed from the top of the stage coach were several species of cacti and the creosote bush, Larea Mexicana Moric. This shrub grows in nearly all parts of Southern Arizona, and is perfectly at home upon the driest mesa, where, in some years, it is without rain for several continuous months. It has surface roots and frequently grows upon a hard, rocky subsoil. No doubt the gum which covers the leaves like a coat of varnish aids greatly in retarding the evaporation of moisture.

Of the species of cacti found here, Cereus giganteus Engelm., Echinocactus Wislizeni Engelm., and the great tree cactus, Opuntia arborescens Engelm., are the first to catch the traveller's eye.

There is a marked variation in the forms of this latter species as found in the various parts of the territory. This variation is noticeable in length of spines, relative length of joints, color, and in the general aspect of the plant. It is possible that some of these forms may constitute varietal differences, or even specific ones, under more extended study.

As we reached the mountains, our route brought us to the Agua Fria River, which in July was almost dry. The banks of this stream,

together with its tributaries, were in many places covered with large clumps of Prunus demissa Wal. and Rhamnus Californica Esch., with now and then a large cottonwood or black willow showing above them. Platanus racemosa Nutt., Fraxinus pistaciæfolia Torr., and Juglans Californica Watson, were frequently seen nearly covered with the long and heavy vines of Vitis Arizonica Engelm., which grows in great abundance in nearly all the valleys of the territory. In many places the river bed was a complete tangle of Fallugia paradoxa Endlicher, Baccharis glutinosa Pers. and Baccharis salicina T. & G., while in the open places Petunia parviflora Juss., Chamæsaracha coronopus Gray, Euphorbia polycarpa Benth. var. aristida Watson, Euphorbia serpyllifolia Pers., Euphorbia albomarginata T. & G., Croton Texensis, Müll., Polanisia trachysperma T. & G. and Gaura parviflora Dougl., sprang up between the stones or out of the clear white sand. Extending back to the mountains on each side of the river was a dense chapparal of several varieties of Quercus undulatus Torr., densely loaded with acorns. In some localities these shrub oaks fruit so profusely that swine ranches are maintained upon the acorns alone. Mixed in with these oaks were found Arctostaphylos tomentosa, Dougl., Arctostaphylos Nevadensis Gray, Arctostaphylos pungens HBK., Acacia Greggii Gray, and Zizyphus lycioides Gray; while underneath them were growing Hedeoma Drummondii Benth., Verbena ciliata Benth., Mentzelia Wrightii Gray, and several species of Eriogonum. An Opuntia was occasionally seen, while here and there a Yucca baccata Torr. extended its long filamentous leaves in all directions, or an Agave Parryi Engelm. projected its scape high in the air. A few straggling spears of grass were found, mostly Bouteloua racemosa Lag. and Muhlenbergia Texana Thur. with a frequent bunch of Hilaria rigida Scrib. At this season the annuals were mostly scorched and destroyed by the prolonged drouth.

Traveling several miles northwestward from Big Bug, I entered the cañon to which I previously referred, and almost instantly found myself under the shade of Quercus Emoryi Torr., Alnus oblongifolia Torr., and Platanus racemosa Nutt. At either side, growing from the steep mountain slopes, were Juniperus Californica Carr. var. Utahensis Engelm., Juniperus pachyphlœa Torr., Pinus monophylla Torr. & Frem., and Canotia holacantha Torr. At my feet were many cones from Pinus ponderosa Dougl. which had been washed down by the stream from a dozen or more miles up the cañon.

Ascending the cañon, the banks of the stream on either side for rods are lined with the beautiful Aquilegia chrysantha Gray. Growing from the water were large bunches of Juncus tenuis Willd. and Scirpus pun-

gens Vahl., out of which were peeping the bright yellow flowers of Mimulus pilosus Watson. Here and there along the banks I gathered Nicotiana attenuata Torr., Nicotiana trigonophylla Dunal., Mimulus luteus L., Polygonum incarnatum Ell., Coreopsis cardaminaefolia Torr.& Gray, Asclepiodora decumbens Gray, Erythræa venusta Gray, Ambrosia psilostachya DC., Oxalis violacea L., Thalictrum Fendleri Engelm., Solidago Missouriensis Nutt., Solidago Canadensis L., Krameria parvifolia Benth., Aster ericæfolius Rothr., Viola Canadensis L., var. scopulorum, Œnothera albicaulis Nutt., Polygala hemipterocarpa Gray, Petalostemon multiflorus Nutt., Bœrhaavia spicata Choisy, Solanum nigrum L., Erigeron divergens Torr. & Gray, Helianthus petiolaris Nutt., Riddellia Cooperi Gray, Nama hispidum Gray, and Maurandia Wizlizeni Engelm.

Further up the cañon the stream is shut in by almost perpendicular walls of rock. In many places where the water slowly seeps through small fissures in these rocky walls, Mimulus cardinalis Dougl., one of the most beautiful of wild flowers, was growing in abundance. Here also were found Mirabilis multiflora Desf., and Heuchera parvifolia Nutt. In many places large areas of Pteris aquilina L. spread their broad fronds in the shade of the protecting rocks.

On my return to the station, my plant-can contained more than seventy-five species in fit condition for herbarium specimens.—J. W. Toumey, *Tuscon, Arizona.*

EDITORIAL.

Botanical authority seems to be following the same lines of evolution as political. It began with a system of tyranny or dictatorship that vested all such authority in a single individual. Linnæus seems to have ruled the botanical world with a rod of iron, and his word was law. There next followed the reign of a botanical aristocracy, whose spirit was not merely to snub but even to suppress the work of the less favored. Naturally, the spirit of freedom and independence gradually increased, and numerous became the revolts against self-constituted authority.

Our own country has passed through the period of a botanical aristocracy, and there is a good deal of written and unwritten history concerning rank injustice done to both worthy but unknown botanists and known but underrated botanists. A new generation, however, has come to the front; one in which the spirit of democracy is prevalent,

one that proposes to fight not only its own battles but also those of all ancient neglected worthies.

THE THING TO OBSERVE is that we are slipping rapidly away from the time when a few persons or a few places represented the concentration of botanical authority, and are upon the threshold of a new order of things in which the voice of authority is to come from "the people." There may not be greater rivalry in feeling, but there will be far more successful rivalry; and the botanical landscape will represent a uniform forest rather than a cluster of sequoias towering in the midst of their lowly neighbors. Everything wrought out will have to run the gauntlet of the many instead of the few.

THIS CONDITION of things has been brought about by the wonderful spread of scientific training and the consequent development of independent thinking. In a general sense this is a far more desirable state of affairs, for it develops hundreds of efficient workers where there was only one before. It also has certain disadvantages common to all democracy. While it brings individual freedom it permits follies which a strong central power would have repressed. The new order of things, therefore, must be expected to be more of a "lo here" and "lo there" state of affairs, full of "fads" and erratic movements, and abounding more in worthless than worthy literature, but there is in it more of hope and promise for the rapid development of botanical science than under the former régime, for an aristocracy is always inclined to be ultra-conservative. It is only rebels who are apt to be extremists, and when there is nothing left to rebel against they usually settle down into staid and comfortable citizens.

OPEN LETTERS.

The pollination of Orchis spectabilis.

In the spring of 1891 while examining Orchis spectabilis, I was surprised to see the pollen masses, which I had withdrawn on the point of my pencil, turning backward, instead of downward, as one would expect from the position of the stigma below the anthers. When I pushed the pencil point into another flowers the pollen masses were quite out of position to fertilize the pistil. Yet this flower is said to set seed abundantly. Can any of the readers of the GAZETTE throw light upon the matter?—JANE H. NEWELL, *Cambridge, Mass.*

NOTES AND NEWS.

MR. W. W. CALKINS returned to Chicago from his collecting trip in Tennessee May 1.

A MONOGRAPH of the Myxogastres covering 367 octavo pages and illustrated with twelve colored plates has recently been published by Mr. George Massee.

THE MARINE BIOLOGICAL LABORATORY at Wood's Holl opens its fifth season June 1. The botanical instruction will he in charge of Mr. W. A. Setchell of Yale University.

DR. F. ELFVING, of the University of Helsingfors, and Dr. M. Möbius, of the University of Heidelberg, have each been promoted from docent to a professorship in their respective institutions.

DR. J. C. ARTHUR sails for Europe June 4, for a two months' trip, principally in Germany. He goes largely to ascertain the possibilities and promote the interests of the Botanical Congress of 1893.

THE HERBARIUM of the University of Minnesota is growing so rapidly that the item published in the March number was out of date. That collection now contains upward of 60,000 plants, of which 25,000 are spermaphytes.

MM. L. MESCHINELLI AND S. SQUINABOL propose to publish, if sufficient encouragement thereto is offered, a work which is ready for press, on the Tertiary flora of Italy. 114 genera of cryptogams and 333 of phanerogams are known from this formation in Italy.

MR. WALTER H. EVANS is now in Arizona, in the employ of the Department of Agriculture, collecting living desert plants for the Columbian Exposition. It is the purpose of the Department to represent as completely as possible the characteristic vegetation of our southwestern arid regions.

AN APPRECIATIVE sketch of Sereno Watson appears in the *Bull. Torr. Bot. Club* (April) from the pen of Mr. Walter Deane. Mr. Deane is peculiarly qualified to write concerning Dr. Watson, as their intimate personal acquaintance brought the subject very often under the observation of the writer.

DR. THOS. C. PORTER has just described (*Bull. Torr. Bot. Club*, April) two new Eupatoriums, one from Tennessee, the other from New Jersey; four new varieties of as many species of Solidago; a new species of Solidago whose name, S. Roanensis, suggests its habitat; and a new Tripsacum from Florida.

THE DISAPPEARANCE of *Desmodium* from our flora, threatened by a botanist who curiously enough can sign himself "O. K.," is emphasized by Anna M. Vail in *Bulletin of Torrey Botanical Club* (April), who presents the synonymy of the genus *Meibomia*, as it occurs in the United States and British America.

THE PRINCIPAL ARTICLE in the last number of *Flora* (1892, Heft 2) is on the photometric movements of plants by F. Oltmanns. Shorter articles are by J. Sachs, physiological notes, A. Doyel on the morphology and development of the starch grains of Pellionia, and F. Noll on the culture of marine algæ in aquaria.

FLORA FRANCISCANA, Part III, presents the following orders and sequence: Papaveraceæ, Nymphæeæ, Sarraceneæ, Drosereae, Laurineae, Berberideae, Ranunculaceae, Sarmentosae (Vitaceae), Araliaceae, Umbelliferae, Corneae, Elaeagneae, Daphnoideae (Thymelaeaceae), Santalaceae, Lorantheae, Caprifoliaceae, Rubiaceae, Valerianeae.

THE USUAL summer courses in botany at Harvard University are announced. Mr. W. F. Ganong and Mr. G. J. Pierce will conduct two courses each in morphology and physiology and in histology, while Mr. A. B. Seymour offers (for advanced students only) two courses, one in general cryptogamic botany and one in economic mycology.

MESSRS. J. K. SMALL and Luther D. Reed will make a botanical expedition during the coming season from the southwestern corner of Virginia to the Mississippi river along the southern border of Kentucky. The region is a rich collecting field but little explored. Those desiring to arrange for the purchase of sets of specimens can address Mr. Reed at Lancaster, Pa.

MR. JOHN S. WRIGHT has accepted the position of botanist in the pharmaceutical establishment of Eli Lilly & Sons, Indianapolis, Ind., as successor to Walter H. Evans, who resigned to take a position in the botanical division of the U. S. Department of Agriculture. Mr. Wright enters upon his duties in June at the completion of his undergraduate studies in Purdue University.

THE SECRETARY of the Society for the Promotion of Agricultural Science has decided to postpone the publication of the proceedings of the society for 1891 until after the next meeting, which occurs in August. The unfortunate delay is necessitated by the failure of the printing firm having the contract to resume work since their establishment was destroyed by fire in January last.

IN THE SUMMER SCHOOL of the University of Wisconsin, courses in botany planned with special reference to high school teachers are offered. One is a "model course," embracing instruction in the method and on the topics which Prof. Barnes thinks desirable and practicable in high schools having limited equipment. Advanced work in anatomy is also offered.

SOME IDEA of the growing attractiveness of the Royal Gardens at Kew may be obtained from the report of the number of visitors in each decennial year, a record which now covers 50 years. In 1841 there were 9,174 visitors; in 1851, 327,900; in 1861, 480,070; in 1871, 577,084; in 1881, 836,676; in 1891, 1,373,753. On a single holiday, (May 26, 1890), the attendance was 106,808.

DR. J. H. SANDBERG, Messrs. D. T. MacDougal and A. A. Heller have gone to Idaho under the auspices of the Botanical Division of the Department of Agriculture to make an extended botanical exploration along the Clear Water river, the Nez Perces Reservation, thence northward to the Bitter Root mountains, and down into the Clark Fork of the Columbia river. Their headquarters are at Lewiston, Idaho.

THE EXPEDITION TO WESTERN AFRICA under the direction of Mr. O. F. Cook, of Syracuse University, has been unfortunate and has accomplished much less than anticipated on account of tropical fever.

Every member of the company has been ill, necessitating a complete change in the original plans. Mr. Cook expects to again attempt to penetrate the interior of Moravia, and then return to America the coming August. The other members of the expedition will probably return sooner.

THE CONSTITUTION and list of members of the Ohio Academy of Sciences have been issued as a twelve-page pamphlet. The Academy was organized Dec. 31, 1891, with fifty-four charter members. The Nebraska Academy of Sciences was organized Jan. 1, 1891, with forty charter members. It has published the constitution and list of members in an eight-page pamphlet, and more recently a twenty-four page pamphlet containing abstracts of papers read at the second annual meeting Dec. 31, 1891, largely botanical.

THE ITALIAN BOTANICAL SOCIETY on behalf of the city of Genoa, Italy, invites the botanists of every nationality to a Botanical International Congress to be held Sept. 4 to 11, 1892, in commemoration of the fourth centennial of the discoveries of Columbus, a citizen of Genoa. It will alsobe the occasion of the opening of a new Botanical Institute and of a horticultural exhibition. Excursions and other festivities are offered by the municipality of Genoa and also by the Botanical Society. It is hoped to make the gathering truly cosmopolitan.

THE JOURNAL OF MYCOLOGY, issued by the Division of Vegetable Pathology of the U. S. Department of Agriculture, is constantly increasing in size and interest. The last number contains seventy pages of original matter on plant diseases and new species of fungi, illustrated with seven plates and several text cuts. Seven publications are reviewed at considerable length, and the number closes with forty-two pages of index to current literature. This index is a most commendable and useful feature and especially as at present conducted. The citations are followed in each case by a brief résumé of contents of the work. The Chief of the Division thoughtfully offers to supply extra copies of the index to those who wish to arrange the numbers in a card catalogue.

AN UNUSUAL NUMBER of Experiment Station bulletins containing botanical matter have been issued in the last month. The Arizona Station proposes (No. 5) to make a study of the native Rumex hymenosepalus, locally known as cañaigre, as a tannin producing plant. F. H. Hillman (Nev., No. 15) describes and illustrates Cuscuta epithymum, C. arvensis, and C. denticulata as pests of alfalfa (Medicago sativa). Fungous diseases of plants and their treatment are discussed by W. C. Sturgis (Conn., No. 111), L. H. Pammel (Iowa, No. 16), S. A. Beach (N. Y., No. 40), S. T. Maynard (Hatch, No. 17), J. C. Arthur (Ind., No. 39) and C. F. Millspaugh (W. Va., No. 21). Geo. F. Atkinson (Ala., No. 36) gives an interesting and extended account of his study of yellow leaf blight of cotton, a physiological disease. The annual reports of New Jersey (1890), Connecticut (1891) and Indiana (1891) Stations also contain matter on plant diseases by B. D. Halsted, R. Thaxter and J. C. Arthur respectively. Nearly all of these articles are well illustrated.

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